

MILITARY SPECIFICATION

MICROCIRCUITS, DIGITAL, BIPOLAR, SCHOTTKY TTL, NAND BUFFERS, MONOLITHIC SILICON

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic, silicon, Schottky TTL, positive NAND buffer microcircuits. Two product assurance classes and a choice of case outlines and lead finishes are provided and are reflected in the complete part number.

1.2 Part number. The complete part number shall be in accordance with MIL-M-38510, and as specified herein.

1.2.1 Device type. The device type shall be as follows:

<u>Device type</u>	<u>Circuit</u>
01	Dual, 4-input, positive NAND buffer

1.2.2 Device class. Device class shall be the product assurance level as defined in MIL-M-38510.

1.2.3 Case outlines. The case outlines shall be designated as follows:

<u>Outline letter</u>	<u>Case outline (see MIL-M-38510, appendix C)</u>
A	F-1 (14-lead, 1/4" x 1/4"), flat package
B	F-3 (14-lead, 3/16" x 1/4"), flat package
C	D-1 (14-lead, 1/4" x 3/4"), dual-in-line package
D	F-2 (14-lead, 1/4" x 3/8"), flat package
X	C-2A (20-terminal, .350" x .350"), square chip carrier package
2	C-2 (20-terminal, .350" x .350"), square chip carrier package

1.3 Absolute maximum ratings.

Supply voltage range - - - - -	-0.5 V dc to +7.0 V dc
Input voltage range - - - - -	-1.2 V dc at -18 mA to +5.5 V dc
Storage temperature range - - - - -	-65°C to +150°C
Maximum power dissipation (P _D) - - - - -	121 mW dc per buffer 1/
Lead temperature (soldering, 10 seconds) - -	+300°C
Thermal resistance, junction-to-case (θ _{JC}):	
Cases A, B, C, D, X, and 2 - - - - -	See MIL-M-38510, appendix C
Junction temperature (T _J) 2/- - - - -	+175°C

1/ Must withstand the added P_D due to short circuit condition (e.g., I_{OS}) at one output for 5 seconds duration.

2/ Maximum junction temperature shall not be exceeded except for allowable short duration burn-in screening conditions in accordance with method 5004 of MIL-STD-883.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Air Development Center (RBE-2), Griffiss AFB, NY 13441, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Recommended operating conditions.

Supply voltage (V_{CC})	- - - - -	4.5 V dc minimum to 5.5 V dc maximum
Minimum high-level input voltage (V_{IH})	- -	2.0 V dc
Maximum low-level input voltage (V_{IL})	3/-	0.8 V dc
Normalized fan-out (each output)	4/- - -	30 maximum
Case operating temperature range (T_C)	- -	-55°C to +125°C

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specification and standard, form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Defense Index of Specifications and Standards and supplement thereto, cited in the solicitation.

SPECIFICATION

MILITARY

MIL-M-38510 - Microcircuits, General Specification for.

STANDARD

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

(Copies of the specification and standard required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets, or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Detail specification. The individual item requirements shall be in accordance with MIL-M-38510, and as specified herein.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be in accordance with MIL-M-38510 and as specified herein.

3.2.1 Logic diagram and terminal connections. The logic diagram and terminal connections shall be as specified on figure 1.

3.2.2 Truth table. The truth table shall be as specified on figure 2.

3.2.3 Schematic circuits. Schematic circuits shall be submitted to the preparing activity prior to inclusion of a manufacturer's device in the specification and shall be submitted to the qualifying activity and agent activity (DESC-ECS) as a prerequisite for qualification. All qualified manufacturers schematics shall be maintained by the agent activity and will be available upon request.

3.2.4 Case outlines. The case outlines shall be as specified in 1.2.3.

3/ $V_{IL} = 0.7$ V dc at +125°C.

4/ Device will fan-out in both high and low levels to the specified number of inputs of the same device type as that being tested.

TABLE I. Electrical characteristics.

Test	Symbol	Conditions $-55^{\circ}\text{C} \leq T_C \leq +125^{\circ}\text{C}$	Limits		Unit
			Min	Max	
High-level output voltage	V_{OH}	$V_{CC} = 4.5 \text{ V}$, $V_{IL} = 0.8 \text{ V}$ $I_{OH} = -3 \text{ mA}$ <u>1/</u>	2.5		V
		At $T_C = +125^{\circ}\text{C}$, $V_{IL} = 0.7 \text{ V}$			
Low-level output voltage	V_{OL}	$V_{CC} = 4.5 \text{ V}$, $I_{OL} = 60 \text{ mA}$ $V_{IN} = 2.0 \text{ V}$ for all inputs of gate under test <u>1/</u>		0.5	V
		At $T_C = +125^{\circ}\text{C}$		0.45	V
Input clamp voltage	V_{IC}	$V_{CC} = 4.5 \text{ V}$, $I_{IN} = -18 \text{ mA}$ $T_C = +25^{\circ}\text{C}$		-1.2	V
Collector cut-off current	I_{CEX}	$V_{CC} = 5.5 \text{ V}$, $V_{IL} = \text{GND}$, $V_{IH} = 5.5 \text{ V}$, $V_{OH} = 5.5 \text{ V}$		250	μA
High-level input current	I_{IH1}	$V_{CC} = 5.5 \text{ V}$, $V_{IN} = 2.7 \text{ V}$ <u>2/</u>		100	μA
High-level input current	I_{IH2}	$V_{CC} = 5.5 \text{ V}$, $V_{IN} = 5.5 \text{ V}$ <u>2/</u>		1	mA
Low-level input current	I_{IL}	$V_{CC} = 5.5 \text{ V}$, $V_{IN} = 0.5 \text{ V}$ <u>1/</u>	-1	-4	mA
Short-circuit output current	I_{OS}	$V_{CC} = 5.5 \text{ V}$ <u>2/</u> <u>3/</u>	-50	-225	mA
High-level supply current per buffer	I_{CCH}	$V_{CC} = 5.5 \text{ V}$ <u>2/</u> , $V_{IN} = 0 \text{ V}$		9	mA
Low-level supply current per buffer	I_{CCL}	$V_{CC} = 5.5 \text{ V}$ <u>1/</u> , $V_{IN} = 5.5 \text{ V}$		22	mA
Propagation delay time, high-to-low level	t_{PHL}	$C_L = 50 \text{ pF}$, $R_L = 93\Omega$	2	8.5	ns
Propagation delay time, low-to-high level	t_{PLH}	$C_L = 50 \text{ pF}$, $R_L = 93\Omega$	2	8.5	ns

1/ All unspecified inputs at 5.5 volts.2/ All unspecified inputs grounded.3/ Not more than one output should be shorted at a time.

3.3 Lead material and finish. The lead material and finish shall be in accordance with MIL-M-38510 (see 6.4).

3.4 Electrical performance characteristics. Unless otherwise specified, the electrical performance characteristics are specified in table I, and shall apply over the full recommended case operating temperature range.

3.5 Electrical test requirements. The electrical test requirements for each device class shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table III.

3.6 Marking. Marking shall be in accordance with MIL-M-38510.

3.7 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 9 (see MIL-M-38510, appendix E).

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (see table III)	
	Class S devices	Class B devices
Interim electrical parameters (method 5004)	1	1
Final electrical test parameters (method 5004)	1*,2,3, 9,10,11	1*,2,3, 9
Group A test requirements (method 5005)	1,2,3, 9,10,11	1,2,3, 9,10,11
Group B test requirements (method 5005) subgroup 5	1,2,3, 9,10,11	N/A
Group C end-point electrical parameters (method 5005)	N/A	1,2,3
Group D end-point electrical parameters (method 5005)	1,2,3	1,2,3

* PDA applies to subgroup 1 (see 4.2c).

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-M-38510 and methods 5005 and 5007, as applicable, of MIL-STD-883, except as modified herein.

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

- a. Burn-in (method 1015 of MIL-STD-883).
 - (1) Test condition D or E, using the circuit shown on figure 3, or equivalent.
 - (2) $T_A = +125^{\circ}\text{C}$ minimum.
- b. Interim and final electrical test parameters shall be as specified in table II, except interim electrical parameters test prior to burn-in is optional at the discretion of the manufacturer.
- c. The percent defective allowable (PDA) shall be as specified in MIL-M-38510.

4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4.1 Group A inspection. Group A inspection shall be in accordance with table I of method 5005 of MIL-STD-883 and as follows:

- a. Test shall be as specified in table II herein.
- b. Subgroups 4, 5, 6, 7, and 8 shall be omitted.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of method 5005 of MIL-STD-883. Electrical parameters shall be as specified in table II herein.

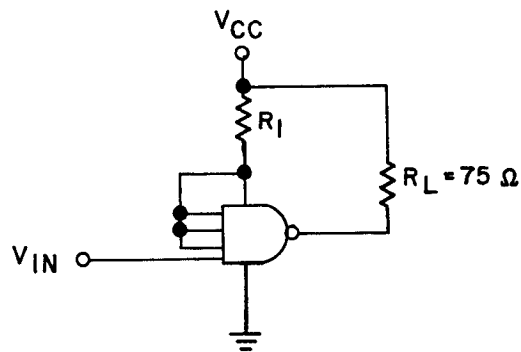
4.4.3 Group C inspection. Group C inspection shall be in accordance with table III of method 5005 of MIL-STD-883 and as follows:

- a. End-point electrical parameters shall be as specified in table II herein.
- b. Steady-state life test (method 1005 of MIL-STD-883) conditions, or equivalent.
 - (1) Test condition D or E, using the circuit shown on figure 3, or equivalent.
 - (2) $T_A = +125^{\circ}\text{C}$ minimum.
 - (3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

4.4.4 Group D inspection. Group D inspection shall be in accordance with table IV of method 5005 of MIL-STD-883. End-point electrical parameters shall be as specified in table II herein.

4.5 Methods of inspection. Methods of inspection shall be specified as follows:

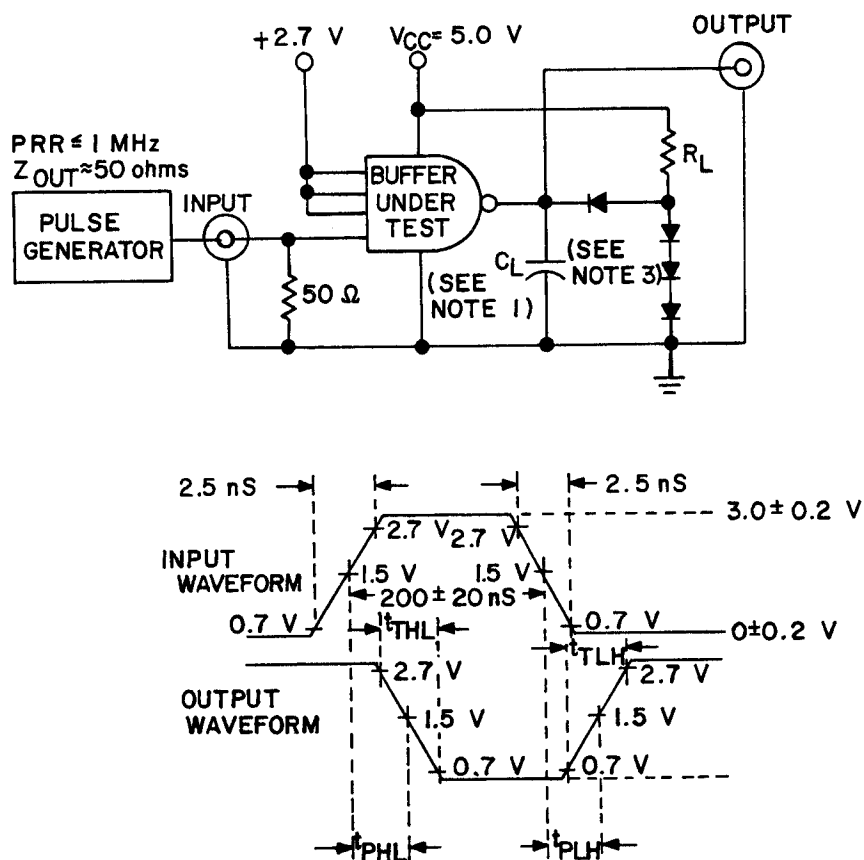
4.5.1 Voltage and current. All voltages given are referenced to the microcircuit ground terminal. Currents given are conventional and positive when flowing into the referenced terminal.

Device type 01

NOTES:

1. One input of each buffer shall be driven. The remaining inputs of each buffer shall be connected to V_{CC} through the appropriate current limiting resistor.
2. V_{CC} and R_1 are such that the minimum voltage at the device terminal is 5 volts.
3. If parallel excitation is used, CP = 100 kHz \pm 50% square wave, duty cycle = 50 \pm 15%, V_{IL} = -0.5 V min to 0.8 V max; V_{IH} = 2.0 V min to 5.5 V max.

FIGURE 3. Burn-in and life test circuit.

Device type 01

NOTES:

1. Including scope probe, wiring, and stray capacitance, without package in test fixture. $C_L = 50 \text{ pF}$ minimum.
2. Voltage measurements are to be made with respect to network ground terminal.
3. All diodes are 1N3064 or equivalent.
4. $R_L = 93 \Omega \pm 5\%$.

FIGURE 4. Switching time test circuit.

TABLE III. Group A inspection for device type 0L.
Terminal condition (pins not designated may be high ≥ 2.0 V or low ≤ 0.8 V, or open).

Subgroup	Symbol	MIL-STD-883 method	Cases A, B, C, D		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Limits		Unit
			Test no.	Cases 1, 2																Min	Max	
1 T _C = +25°C	V _{OL}	3007 3007	1	2.0 V	2.0 V	2.0 V	2.0 V	2.0 V	60 mA	GND	GND	00 mA	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	4.5 V	1Y 2Y		0.5 V 0.5	
			2	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V														
	V _{OH}	3006	3	0.8 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	-3 mA				5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	2.5	1Y		
			4	5.5 V	0.8 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V												
			5	"	"	"	"	"	"	"												
			6	"	"	"	"	"	"	"												
			7	"	"	"	"	"	"	"												
			8	"	"	"	"	"	"	"												
			9	"	"	"	"	"	"	"												
			10	"	"	"	"	"	"	"												
V _{IC}	3006	11	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA											1A			
		12	"	"	"	"	"	"	"										1B			
		13	"	"	"	"	"	"	"										1C			
		14	"	"	"	"	"	"	"										1D			
		15	"	"	"	"	"	"	"										2A			
		16	"	"	"	"	"	"	"										2B			
		17	"	"	"	"	"	"	"										2C			
		18	"	"	"	"	"	"	"										2D			
I _{OS}	3011 3011	19	GND	GND	GND	GND	GND	GND											1Y			
		20																	2Y			
I _{IH1}	3010	21	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V											1A		
		22	GND	GND	GND	GND	GND	GND	GND											1B		
		23	"	"	"	"	"	"	"											1C		
		24	"	"	"	"	"	"	"											1D		
		25	"	"	"	"	"	"	"											2A		
		26	"	"	"	"	"	"	"											2B		
		27	"	"	"	"	"	"	"											2C		
		28	"	"	"	"	"	"	"											2D		
I _{IH2}	3010	29	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V											1A		
		30	GND	GND	GND	GND	GND	GND	GND											1B		
		31	"	"	"	"	"	"	"											1C		
		32	"	"	"	"	"	"	"											1D		
		33	"	"	"	"	"	"	"											2A		
		34	"	"	"	"	"	"	"											2B		
		35	"	"	"	"	"	"	"											2C		
		36	"	"	"	"	"	"	"											2D		
I _{IL}	3009 3009	37	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V											1A			
		38	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V										1B			
I _{CEX}		39	GND	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V											1Y			
		40	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V										2Y			

See footnote at end of table.

TABLE III. Group A inspection for device type 01 - Continued.
Terminal condition (pins not designated may be high ≥ 2.0 V or low ≤ 0.8 V, or open).

Subgroup	Symbol	MIL-STD-883 method	Cases A, B, C, D, A, Z	Cases 1-16														Measured terminal	Limits		Unit
				1	2	3	4	5	6	7	8	9	10	11	12	13	14		Min	Max	
1 $T_C = +25^\circ\text{C}$	I_{IL}	3009	Test no.	1A	1B	1C	1D	1E	1F	1G	1H	1I	1J	1K	1L	1M	1N	1O	1P	1Q	1R
				41	5.5 V	5.5 V	0.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V	5.5 V
				42	"	"	5.5 V	0.5 V	"	"	"	"	"	"	"	"	"	"	"	"	"
				43	"	"	5.5 V	5.5 V	"	"	"	"	"	"	"	"	"	"	"	"	"
				44	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
				45	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2	I_{CCL} I_{CCH}	3005 3005	Test no.	46	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
				47	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
3	I_{CCL} I_{CCH}	3005 3005	Test no.	48	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
				49	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
9 $T_C = +25^\circ\text{C}$	t_{PHL} t_{PLH} t_{PLH}	3003 (fig. 4)	Test no.	50	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
				51	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
				52	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
				53	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
10 $T_C = +125^\circ\text{C}$	t_{PHL} t_{PLH} t_{PLH}	3003 (fig. 4)	Test no.	54	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
				55	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
				56	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
				57	IN	IN	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V	2.7 V
11	I_{CCL} I_{CCH}	3005 3005	Test no.	58	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
				59	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"

1/ Cases X and 2 pins not designated are N/C.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Intended use. Microcircuits conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Ordering data. The acquisition document should specify the following:

- a. Complete part number (see 1.2).
- b. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- c. Requirements for certificate of compliance, if applicable.
- d. Requirements for notification of change of product or process to the contracting activity in addition to notification to the qualifying activity, if applicable.
- e. Requirements for failure analysis (including required test condition of method 5003 of MIL-STD-883), corrective action, and reporting of results, if applicable.
- f. Requirements for product assurance options.
- g. Requirements for special carriers, lead lengths, or lead forming, if applicable. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.
- h. Requirements for "JAN" marking.

6.3 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-M-38510, MIL-STD-1331, and as follows:

GND	- - - - -	Ground, zero voltage potential
I _{IN}	- - - - -	Current flowing into an input terminal
V _{IN}	- - - - -	Voltage level at an input terminal

6.4 Logistic support. Lead materials and finishes (see 3.3) are interchangeable. Unless otherwise specified, microcircuits acquired for Government logistic support will be acquired to device class B (see 1.2.2) and lead material and finish C (see 3.3). Longer length leads and lead forming shall not affect the part number.

6.5 Substitutability. The cross-reference information below is presented for the convenience of users. Microcircuits covered by this specification will functionally replace the listed generic-industry type. Generic-industry microcircuit types may not have equivalent operational performance characteristics across military temperature ranges or reliability factors equivalent to MIL-M-38510 device types and may have slight physical variations in relation to case size. The presence of this information shall not be deemed as permitting substitution of generic-industry types for MIL-M-38510 types or as a waiver of any of the provisions of MIL-M-38510.

<u>Military device</u> <u>type</u>	<u>Generic-industry</u> <u>type</u>
01	54S40

6.6 Manufacturers' designation. Manufacturers' circuits which form a part of this specification are designated with an "X" as shown in table IV herein.

TABLE IV. Manufacturers' designation.

Device type	Manufacturer		
	Circuit A	Circuit B	Circuit C
	Texas Instruments	Signetics	Fairchild
01	X	X	X

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:
 Army - ER
 Navy - EC
 Air Force - 17

Review activities:
 Army - AR, MI
 Navy - OS, SH
 Air Force - 11, 19, 85, 99
 DLA - ES

User activities:
 Army - SM
 Navy - AS, CG, MC

Preparing activity:
 Air Force - 17

Agent:
 DLA - ES

(Project 5962-1051)